WHAT IS CLAIMED IS:

1. A lithium secondary battery comprising an electrode and a nonaqueous electrolyte, the electrode comprising an active material layer provided on a current collector and containing an active material which is capable of electrochemically occluding and releasing lithium and having cracks formed in the layer by occlusion and releasing of lithium, the cracks of the active material layer being filled with the nonaqueous electrolyte in the form of a solid electrolyte.

2. The lithium secondary battery according to claim 1, wherein the entirety of the nonaqueous electrolyte is the solid electrolyte.

3. The lithium secondary battery according to claim 1, wherein the nonaqueous electrolyte partially comprises the solid electrolyte.

4. The lithium secondary battery according to claim 1, wherein the solid electrolyte is a gel polymer electrolyte comprising a polymer and an electrolyte containing a lithium salt.

5. The lithium secondary battery according to claim 4, wherein the polymer is a polyether solid polymer, polycarbonate solid polymer, polyacrylonitrile solid polymer, copolymers of at least two of these polymers or crosslinked polymers thereof.

6. The lithium secondary battery according to claim 1, wherein a surface roughness (Ra) of a surface of the current collector is at least 0.2 μm.

7. The lithium secondary battery according to claim 1, wherein the current collector is a copper foil, a copper alloy foil or a metal foil having a copper layer or a copper alloy layer on a surface thereof.

8. The lithium secondary battery according to claim 1, wherein the current collector is an electrolytic copper foil, an electrolytic copper alloy foil or a metal foil having an electrolytic copper layer or an electrolytic copper alloy layer on a surface thereof.

9. The lithium secondary battery according to claim 1,

wherein the active material layer is formed by sintering, under a non-oxidizing atmosphere, a slurry comprising particles of the active material and a binder applied on the surface of the current collector.

10. The lithium secondary battery according to claim 9, wherein the binder remains after sintering.

11. The lithium secondary battery according to claim 9, wherein the binder is a polyimide.

12. The lithium secondary battery according to claim 9, wherein the mean diameter of the active material particles is 10 μm or less.

13. The lithium secondary battery according to claim 9, wherein an electrically-conductive powder is mixed in the slurry, and the electrically-conductive powder is included in the active material layer.

14. The lithium secondary battery according to claim 9, wherein the active material layer is formed by coating the slurry

on the current collector, drying the slurry, rolling the dried slurry and then sintering.

15. The lithium secondary battery according to claim 1, wherein the active material layer is deposited on the current collector as a thin film.

16. The lithium secondary battery according to claim 1, wherein the active material is silicon, tin, germanium, aluminum, or an alloy containing these elements.

17. A method for manufacturing a lithium secondary battery comprising a nonaqueous electrolyte and an electrode on which an active material layer containing an active material capable of electrochemically occluding and releasing lithium is formed on a current collector, wherein cracks which are formed in the active material layer by occlusion and release of lithium are filled with a solid electrolyte, comprising:

preparing a temporary-battery comprising the electrode and the electrolyte comprising a lithium salt;

forming cracks in the active material layer by charging and discharging the temporary-battery;

adding a polymerizable monomer to the electrolyte in the temporary-battery and polymerizing the monomer to form the solid electrolyte and to fill the cracks with the solid electrolyte.

18. A lithium secondary battery comprising an electrode and a nonaqueous electrolyte, the electrode comprising an active material layer formed on a current collector by deposition of an active material which is capable of electrochemically occluding and releasing lithium and having cracks formed in the layer by occlusion and releasing of lithium, the cracks of the active material layer being filled with the nonaqueous electrolyte in the form of a solid electrolyte.

19. A method for manufacturing a lithium secondary battery comprising a nonaqueous electrolyte and an electrode on which an active material layer containing an active material capable of electrochemically occluding and releasing lithium is formed as a thin film on a current collector, wherein cracks which are formed in the active material layer by occlusion and release of lithium are filled with a solid electrolyte, comprising:

preparing a temporary-battery comprising the electrode in which an active material layer containing an active material

capable of electrochemically occluding and releasing lithium is formed by depositing a thin film of the active material on a current collector, and the electrolyte comprising a lithium salt;

forming cracks in the active material layer by charging and discharging the temporary-battery;

adding a polymerizable monomer to the electrolyte in the temporary-battery and polymerizing the monomer to form the solid electrolyte and to fill the cracks with the solid electrolyte.